GERG Project: Development and Set-Up of a New Reference Calorimeter

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Natural gas plays an important role in the worldwide energy supply. For billing purposes, precise metering of volume and superior calorific value are very important. At present, only a few institutions world-wide are able to determine the superior calorific value (SCV) of gases with an uncertainty of less than 0.2 %. For calculations of the superior calorific values of natural gases, the data provided by ISO 6976 "Natural Gas – Calculation of Calorific Value, Density, Relative Density and Wobbe Index from Composition" are used. The uncertainty given in ISO 6976 e.g. for the SCV of methane is at least 0.1 %.

For this reason, a GERG (Groupe Européen de Recherches Gazières) project was set up to develop a new reference calorimeter for determining the SCV of flammable gases (natural gases), based on the principle of a Rossini calorimeter [1]. The six partners mentioned above agreed to build such a calorimeter. The purpose of such a reference calorimeter is to determine the SCV of pure gases and gas mixtures with an uncertainty of less than 0.05 %. In a previous feasibility study [2] a concept for an improved Rossini calorimeter was developed. It consists of a precise mass determination unit for the burned gas, a calorimetric vessel with a burner and an improved temperature measurement.

In the past, several Rossini calorimeters were built by different institutes. It has been shown, that the overall uncertainty budget for the SCV is mainly influenced by the mass determination and the temperature measurement. For this reason most attention was paid to an improvement of both items. An automated weighing device with a gas cylinder and a dummy cylinder was developed. The gas cylinder is permanently coupled with the calorimeter by a capillary. The mass of the burned gas is substituted by a corresponding weight. This experimental procedure together with a new automated balance calibration system leads to a very low uncertainty for the determination of the burned gas.

In the past, platinum resistance thermometry was used for measuring the temperature rise of the calorimetric experiment. This principle shows disadvantages concerning the high response time of the probe and long integration times of the measuring bridge. This may cause several sources of uncertainty not taken into consideration in the past. To overcome this, a platinum resistance thermometer is only used for the measurement of the so-called fore and after period of the experiment, where a slow temperature increase takes place. For the period with the fast temperature increase, a thermistor is used. An assessment of uncertainty according to the "Guide to the Expression of Uncertainty in Measurement" shows that the main contribution to the overall uncertainty results from the temperature measurement. The different items of the calorimeter will be explained.

[1] F.D. Rossini, J Res.NBS **6** 1-35 (1931), **6** 37-49 (1931) **7** 329-330 (1931).
[2] S. Kimpton and P. Ulbig, *Feasibility Study on the Design of a Reference Calorimeter*, Advantica, Physikalisch-Technische Bundesanstalt, Report 2000